

AIRS Monthly Mean Data Analysis and Current Climatology in Giovanni

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Background

- Climate varies naturally on nearly all time and space scales.
- **AIRS (Atmospheric Infrared Sounder) is stable, mature, and well-suited to analyze the climate in the past 14 years.**
- We define an AIRS climatology as the average of all monthly mean geophysical variables for each month.
- **To do this accurately we need to have the best possible monthly mean product.**

Weighted Method (AIRX3STM)

AIRS Records
Overhead
Passes For Each
Grid Square

Count Value
For Each Grid
Square
Accumulated

**Value Of Each
Count Added
Together For
Entire Month**

**Divide Value By
Total Number
Of Counts For
Month**

Unweighted Method

AIRS Records
Overhead Passes
For Each Grid
Square

Count Value For
Each Grid Square
Accumulated

**Value of Each Grid
Square Is
Averaged For The
Day By Total Daily
Recorded Counts**

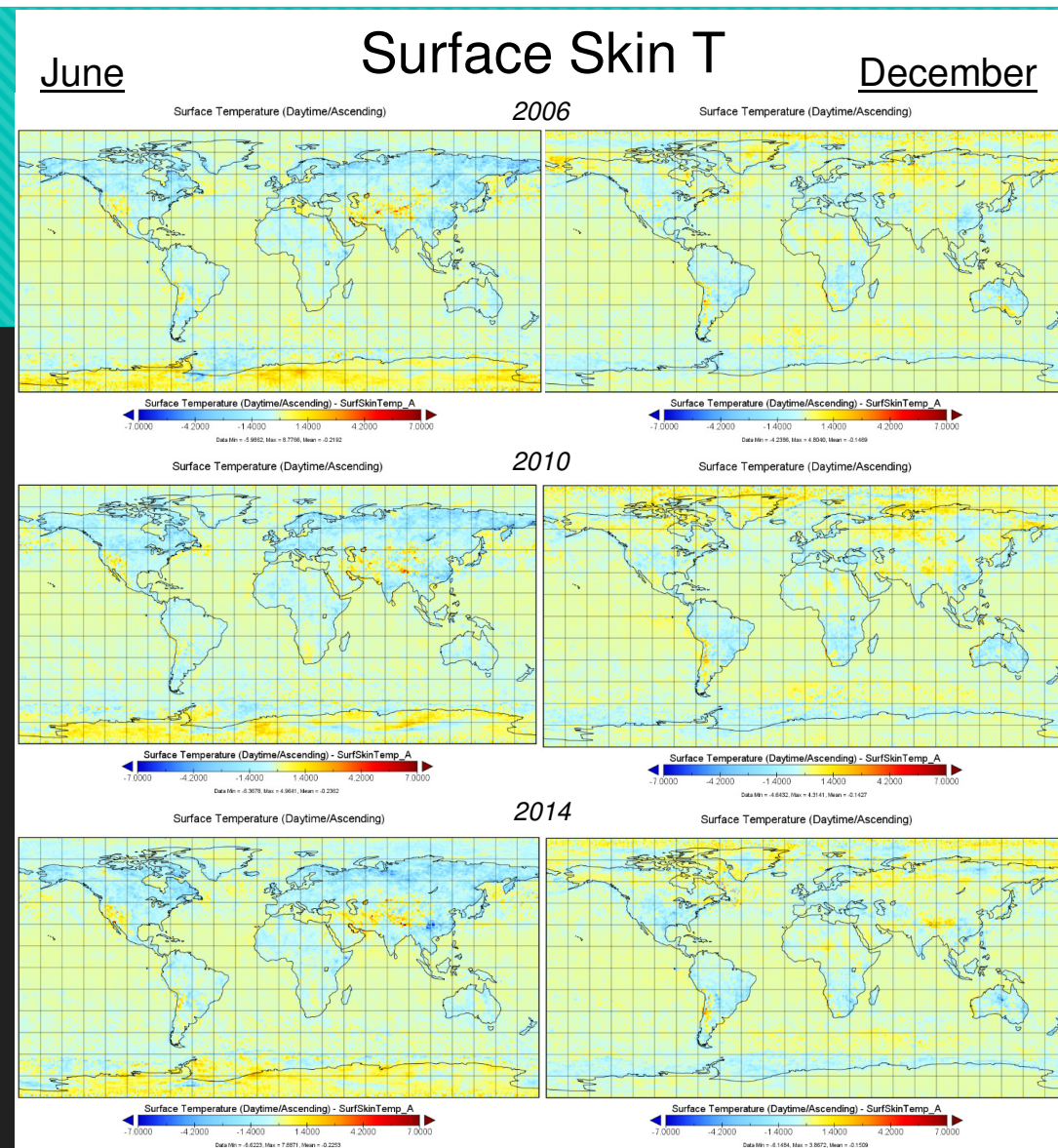
**Monthly Average
Is Created By
Averaging These
Daily Averages**

Method of Approach

- **To assess that there was a significant margin between the un-weighted and weighted algorithms, the difference between the two methods was determined for June and December of three separate years.**
- Datasets used are from AIRS/AMSU version 6 daily/monthly standard product to create difference maps.
- Assessment was done for both the Surface Air Temperature and Surface Skin Temperature variable data sets (Ascending and Descending).

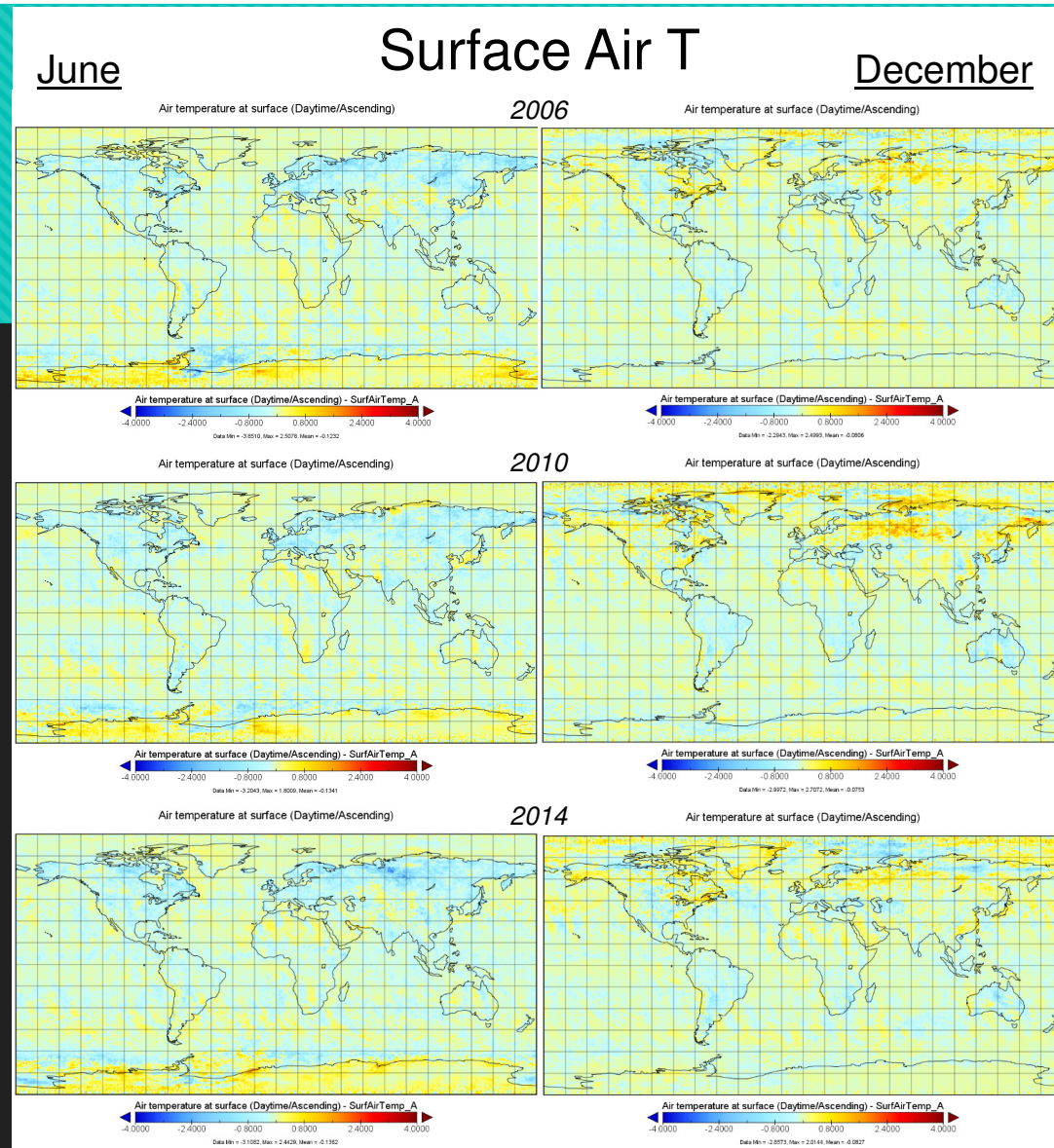
Unweighted-Weighted Ascending

Year	Month	Mean Diff.	RMS Diff.	Min °K	Max °K
<u>2006</u>	June	-0.21	0.68	-5.99	8.78
	Dec.	-0.14	0.47	-4.24	4.80
<u>2010</u>	June	-0.24	0.66	-6.37	4.96
	Dec.	-0.12	0.53	-4.64	4.31
<u>2014</u>	June	-0.24	0.67	-6.62	7.89
	Dec.	-0.15	0.50	-6.15	3.87



Unweighted-Weighted Ascending

Year	Month	Mean Diff.	RMS Diff.	Min °K	Max °K
<u>2006</u>	June	-0.10	0.33	-3.85	2.51
	Dec.	-0.068	0.26	-2.29	2.50
<u>2010</u>	June	-0.11	0.30	-3.20	1.80
	Dec.	-0.052	0.32	-3.00	2.71
<u>2014</u>	June	-0.12	0.32	-3.11	2.44
	Dec.	-0.0704	0.28	-2.86	2.01



The figure displays a 3x2 grid of global maps showing surface skin temperature differences. The rows represent the years 2006, 2010, and 2014. The columns represent the months of June and December. Each map shows the difference between nighttime surface temperature and skin temperature during descent. The color scale ranges from -7.0000 K (blue) to 7.0000 K (red), with 0.0000 K being yellow. The maps show significant seasonal and inter-annual variability, with warmer differences (red/orange) generally appearing in the tropics and during the summer months (June for the Northern Hemisphere, December for the Southern Hemisphere).

June 2006: Surface Temperature (Nighttime/Descending) - SurfSkinTemp_D. Data Min = -4.9754, Max = 3.9596, Mean = -0.1197.

December 2006: Surface Temperature (Nighttime/Descending) - SurfSkinTemp_D. Data Min = -5.9323, Max = 6.6632, Mean = -0.1246.

June 2010: Surface Temperature (Nighttime/Descending) - SurfSkinTemp_D. Data Min = -4.7240, Max = 3.3393, Mean = -0.1328.

December 2010: Surface Temperature (Nighttime/Descending) - SurfSkinTemp_D. Data Min = -6.9703, Max = 3.2392, Mean = -0.1199.

June 2014: Surface Temperature (Nighttime/Descending) - SurfSkinTemp_D. Data Min = -5.2266, Max = 3.9367, Mean = -0.1301.

December 2014: Surface Temperature (Nighttime/Descending) - SurfSkinTemp_D. Data Min = -7.2736, Max = 3.2365, Mean = -0.1396.

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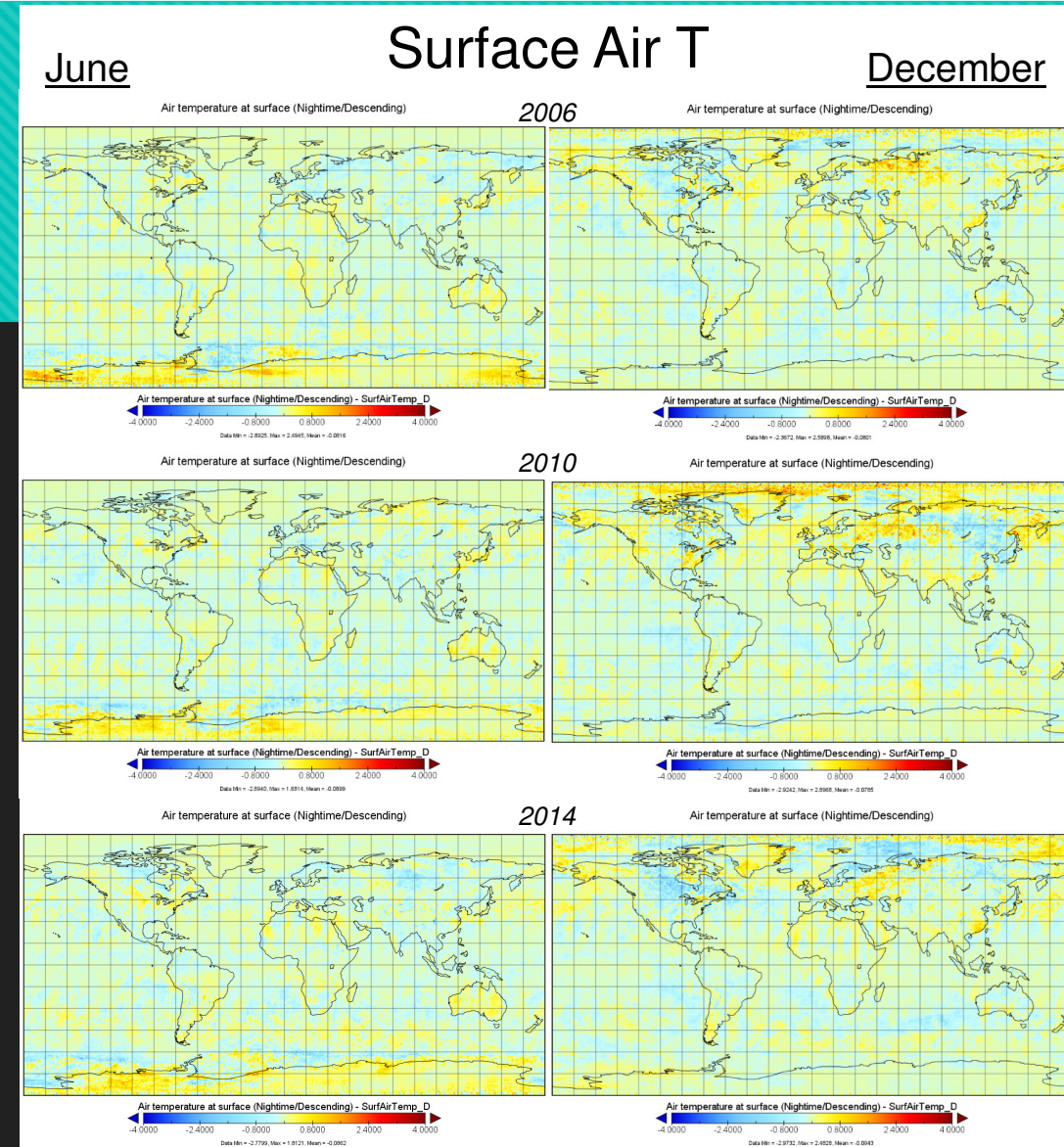
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Unweighted-Weighted Descending`

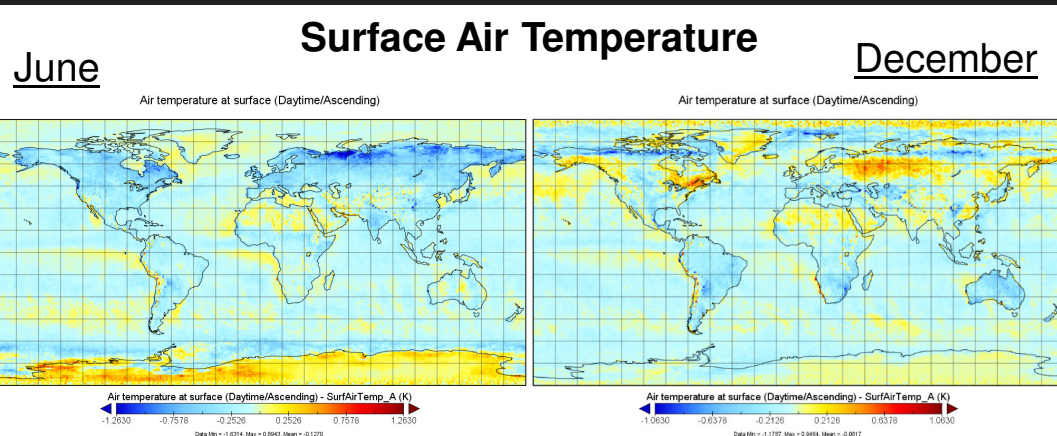
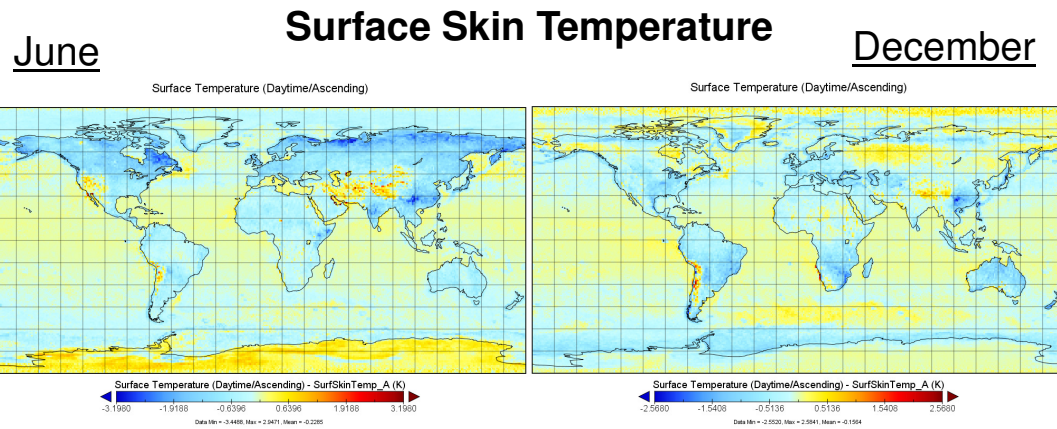
Year	Month	Mean Diff.	RMS Diff.	Min °K	Max °K
<u>2006</u>	June	-0.058	0.27	-2.89	2.49
	Dec.	-0.069	0.27	-2.37	2.59
<u>2010</u>	June	-0.064	0.25	-2.89	1.68
	Dec.	-0.048	0.34	-2.92	2.90
<u>2014</u>	June	-0.067	0.26	-2.78	1.81
	Dec.	-0.086	0.31	-2.97	2.48



Results

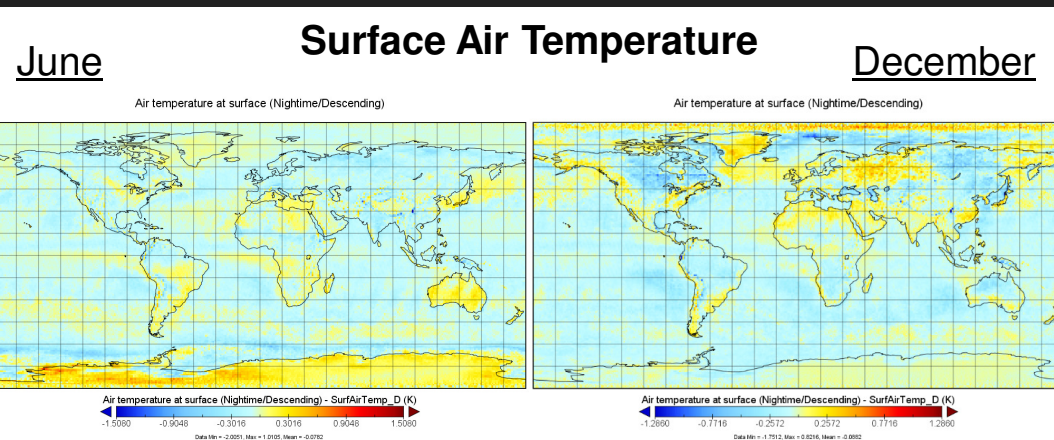
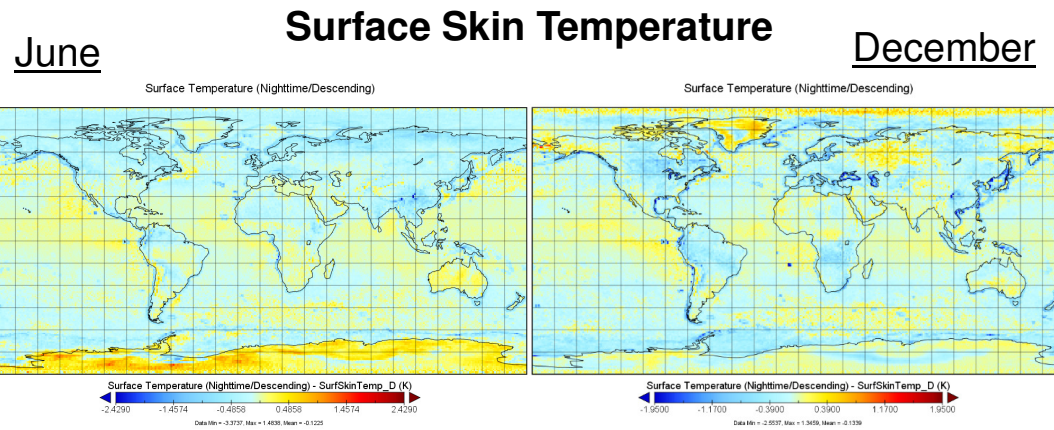
- **There is a consistent, notable, difference between the unweighted monthlies and the existing weighted monthlies, with the largest differences for Surface Skin around 8 degrees K and for Surface Air around 5 degrees K.**
- The surface skin maps overall showed higher T differences than the surface air maps, which might be explained by the higher heating rate that land has compared to air.
- **The unweighted monthlies were consistently warmer near the winter polar regions. (June: South Pole, December: North Pole)**

UW-W Climatology Diff. Ascending



Variable	Month	Mean Diff.	RMS Diff.	Min °K	Max °K
<u>Surf.</u> <u>Skin</u>	June	-0.244	0.572	-3.45	2.95
	Dec.	-0.158	0.340	-2.55	2.58
<u>Surf.</u> <u>Air</u>	June	-0.119	0.266	-1.63	0.89
	Dec.	-0.0744	0.157	-1.18	0.95

UW- W Climatology Diff. Descending



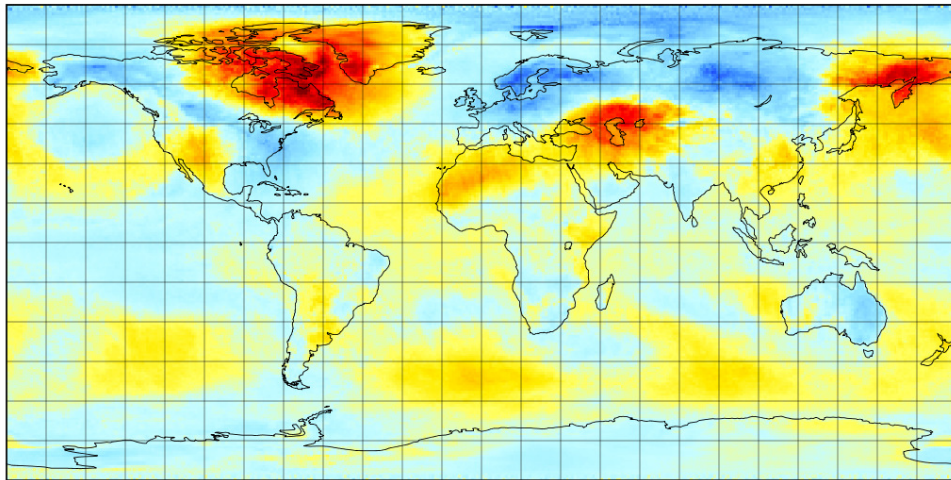
Variable	Month	Mean Diff.	RMS Diff.	Min °K	Max °K
<u>Surf. Skin</u>	June	-0.140	0.338	-3.37	1.48
	Dec.	-0.135	0.277	-2.55	1.35
<u>Surf. Air</u>	June	-0.081	0.199	-2.01	1.01
	Dec.	-0.078	0.160	-1.75	0.82

Results, Continued

- **Differences between the climatology created with un-weighted data and the climatology created with the existing AIRS weighted monthly products showed similar regional differences when compared to the monthly maps.**
- **The maps of the Climatologies show differences up to 3 degrees K.**
- **The regional T differences are much less concentrated in the months between June and December**

Examples of Anomaly Maps Created from the Unweighted Climatology and Monthly Data (From December 2010)

Air temperature at surface (Daytime/Ascending)

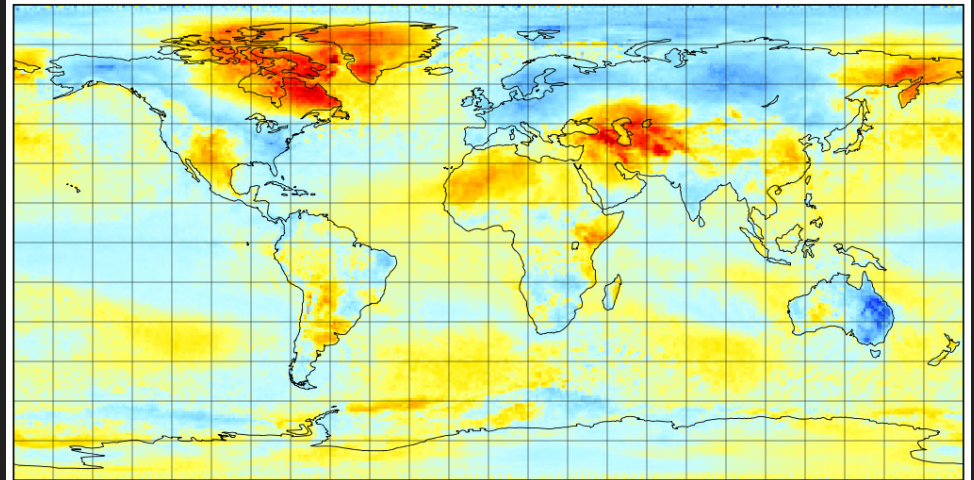


Air temperature at surface (Daytime/Ascending) - Air temperature at surface (Daytime/Ascending) (K)

-9.9960 -5.9976 -1.9992 1.9992 5.9976 9.9960

Data Min = -9.7466, Max = 11.2449, Mean = 0.0197

Surface Temperature (Daytime/Ascending)

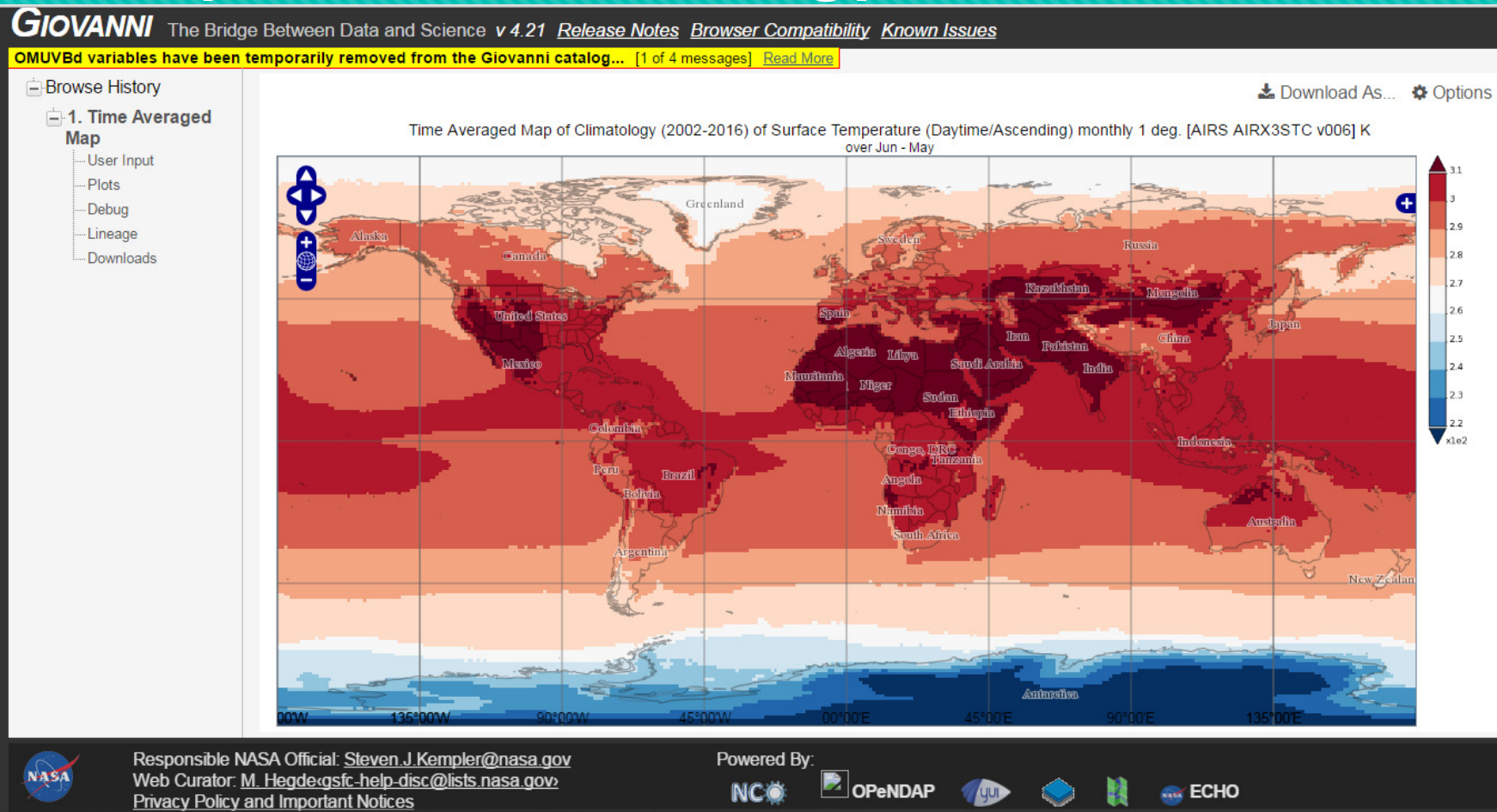


Surface Temperature (Daytime/Ascending) - Surface Temperature (Daytime/Ascending) (K)

-13.1300 -7.8780 -2.6260 2.6260 7.8780 13.1300

Data Min = -12.3054, Max = 13.9627, Mean = -0.0547

Sample AIRS Climatology Plot on Giovanni



Using AIRS Climatology to Show Indication of El Niño

EARTHDATA Data Discovery ▾ DAACs ▾ Community ▾ Science Disciplines ▾

GIOVANNI The Bridge Between Data and Science v 4.21 [Release Notes](#) [Browser Compatibility](#) [Known Issues](#)

OMUVBd variables have been temporarily removed from the Giovanni catalog... [1 of 4 messages] [Read More](#)

Select Plot

☐ Maps: [Select...](#) ☐ Comparisons: [Select...](#) ☐ Vertical: [Select...](#) ☒ Time Series: [Area-Averaged](#) ☐ Miscellaneous: [Select...](#)

Select Date Range (UTC)

YYYY-MM HH:mm
2015 -01 -01 00:00 to 2015 -12 -31 23:59

Valid Range: 2002-09-01 to 2016-07-31

Select Region (Bounding Box or Shapefile)

Format: West, South, East, North
-170,-10,-90,10 [Show Map](#)

Climatology variables will use only the selected month range, January (01) to December (12)

Select Variables

► Disciplines

▼ Measurements

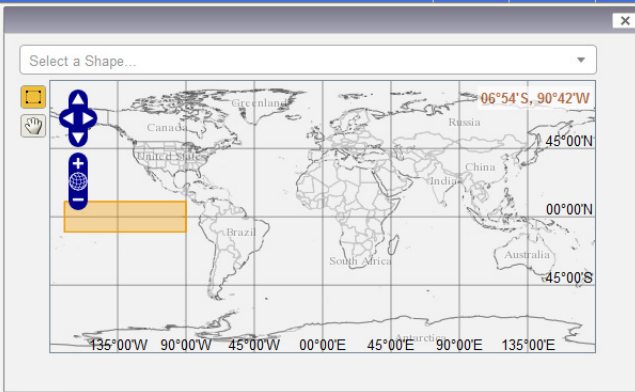
- ☐ Aerosol Index (11)
- ☐ Aerosol Optical Depth (43)
- ☐ Air Pressure (47)
- ☐ Air Temperature (74)
- ☐ Albedo (23)
- ☐ Altitude (4)
- ☐ Angstrom Exponent (24)
- ☐ Atmospheric Moisture (99)
- ☐ Black Carbon (5)
- ☐ Buoyancy (2)
- ☐ CH4 (8)
- ☐ CO (8)
- ☐ CO2 (4)
- ☐ Canopy Water Storage (6)
- ☐ Chlorophyll (19)
- ☐ Cloud Fraction (24)
- ☐ Cloud Properties (66)
- ☐ Component Aerosol Optical Depth (7)
- ☐ Diffusivity (3)
- ☐ Dust (23)
- ☐ Emissivity (15)
- ☐ Energy (12)
- ☐ Erythral UV (6)
- ☐ Evaporation (50)
- ☐ Evapotranspiration (45)
- ☐ Geopotential (7)
- ☐ Grid Std Dev (1)
- ☐ Humidity (136)

Number of matching Variables: 0 of 1849 Total Variable(s) included in Plot: 2

Keyword: [Search](#) [Clear](#)

	Variable	Source	Temp.Res.	Spat.Res.	Begin Date	End Date	Units
<input checked="" type="checkbox"/>	Surface Temperature (Daytime/Ascending) (AIRX3STM v006)	AIRS	Monthly	1°	2002-09-01	2016-09-12	K ▾
<input checked="" type="checkbox"/>	Climatology (2002-2016) of Surface Temperature (Daytime/Ascending) (AIRX3STC v006)	AIRS	Monthly	1°	2002-09-01	2016-07-31	K ▾

Select a Shape...

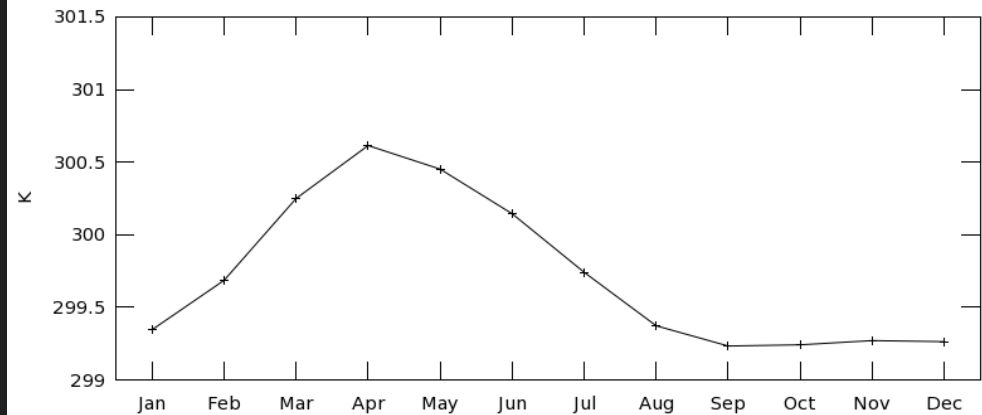


Help Reset Feedback **Plot Data**

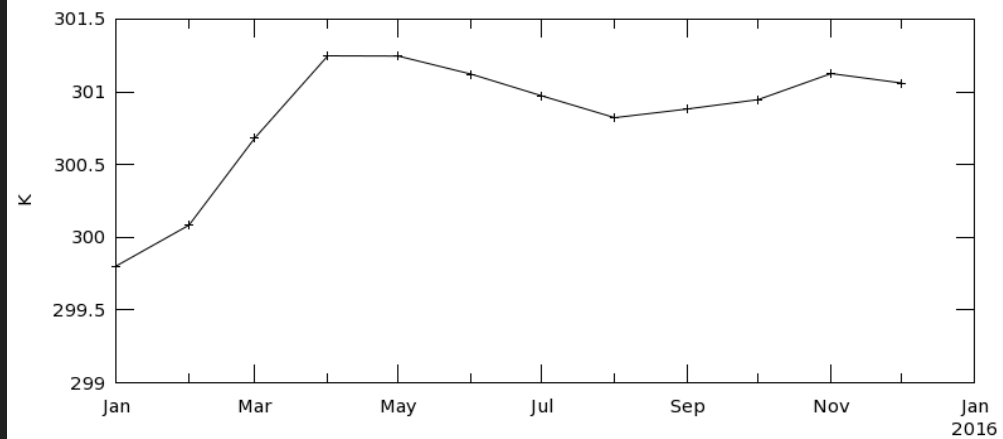
Climatology Time Series

2015 Monthly Time Series

Time Series, Area-Averaged of Climatology (2002-2016) of Surface Temperature (Daytime/Ascending) monthly 1 deg. [AIRS AIRX3STC v006] K over Jan - Nov, Region 170W, 10S, 90W, 10N



Time Series, Area-Averaged of Surface Temperature (Daytime/Ascending) monthly 1 deg. [AIRS AIRX3STM v006] K over 2015-Jan - 2015-Dec, Region 170W, 10S, 90W, 10N



Discussion and Conclusions

- While not clear which averaging method is specifically better at this point, it is clear that more research needs to be done looking into the differences between the two that are shown here.
- **Once fully implemented into Giovanni, we will be able to generate not only visual maps of Climatologies/anomalies, but we will also be able to generate the data sets to go along with those visuals, which will allow for more in depth seasonal and regional analysis of the data.**
- By subtracting our created climatology from monthly averages we can see how our current climate is changing.
- **Analyzing the data from the trial, unweighted, climatology, the largest anomalies, both + and - , for all variables were overwhelmingly present in the (D-J-F) season of almost every year.**